

Workshop Regarding Regulatory Fuels Activities

February 6, 2001

California Environmental Protection Agency



Air Resources Board

Agenda

- ✦ Introductions
- ✦ Diesel fuel Amendments
 - ARB staff presentation
 - Industry presentations
 - Other
- ✦ Other Diesel Issues - Lubricity, Additives, Lube Oils
 - ARB staff presentation
 - Industry presentations
 - Other
- ✦ CaRFG3
 - ARB staff presentation
 - Industry presentations
 - Other
- ✦ Future Activities

EPA Tier II Emissions Standards

- ✦ New diesel vehicle emission reductions:
 - 90% reduction in particulate matter (PM)
 - 95% reduction in NO_x
 - To take effect for 2007 model year

Required Technology Identified to Meet EPA Emission Standards

- ✦ Most viable exhaust after treatment devices capable of meeting emissions standards for PM and NO_x:
 - Catalyzed diesel particulate filters (CDPF)
 - NO_x adsorbers
- ✦ Both systems require very low sulfur in the exhaust to remain effective

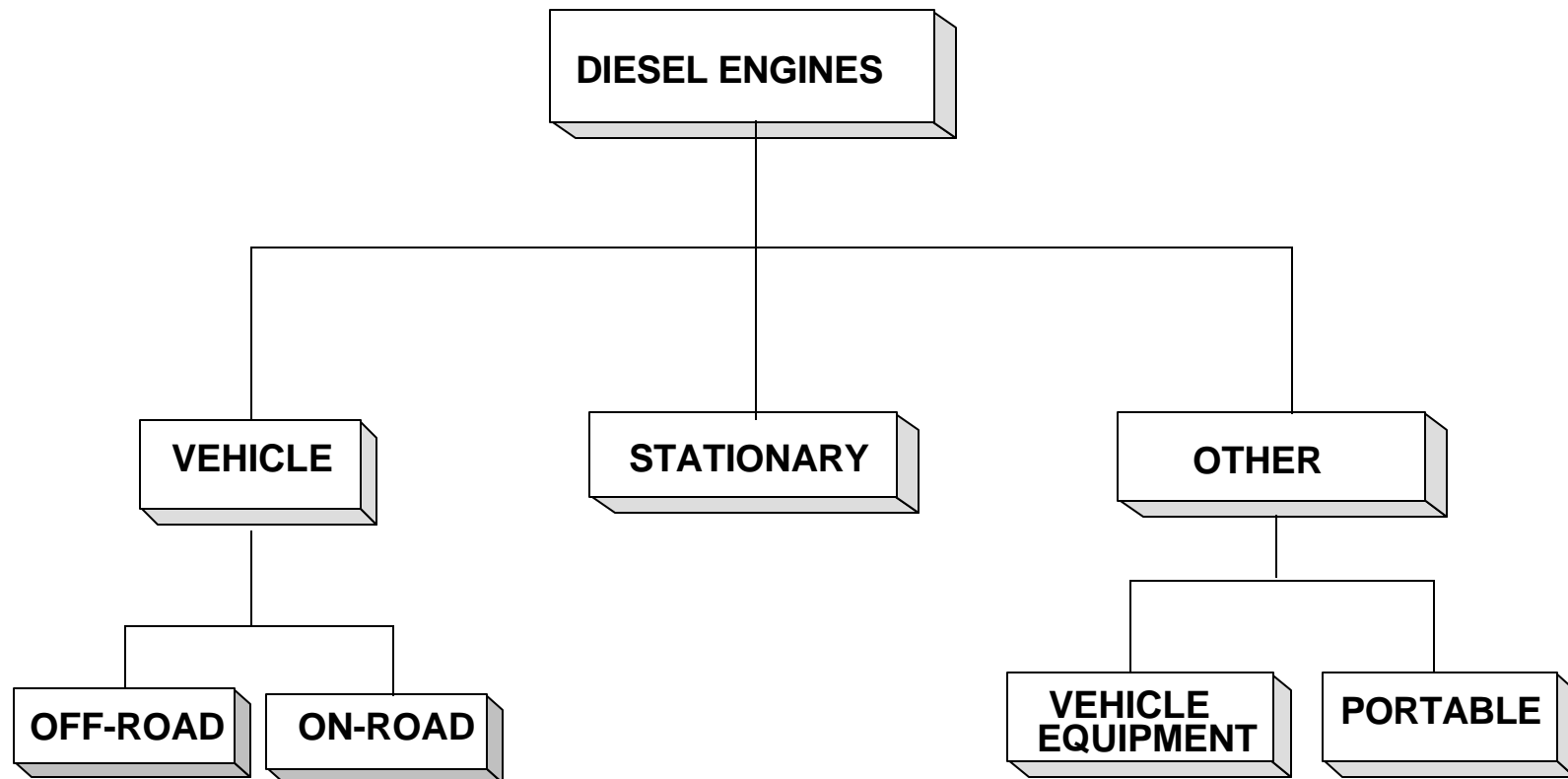
EPA Diesel Fuel Standards

- ✦ Limits on-road diesel fuel sulfur content to 15 ppm
 - Allows sulfur limit to be phased-in
 - Provides several compliance options for small refiners
 - Four year exemption from 15 ppm limit
 - sulfur credit trading
 - Three year exemption from Tier 2 gasoline sulfur limits
 - No changes to cetane or aromatics

Other ARB Diesel Fuel Action

- ✦ Particulate matter identified as a toxic air contaminant in August 1998
- ✦ Diesel risk reduction plan approved by the Board in September 2000

Risk Reduction Plan Addresses All Categories of Diesel-Fueled Engines



Proposed Amendments for California Diesel Fuel

- ✦ Lower CARB diesel sulfur limit to 15 ppm
- ✦ Applies to
 - On-road and off-road vehicle uses
 - Stationary sources (Air Toxic Control Measure)
- ✦ Necessary to implement diesel PM risk reduction plan

Proposed Amendments for California Diesel Fuel (Continued)

- ✦ No changes to aromatic hydrocarbon specifications

Proposed Amendments for California Diesel Fuel (Continued)

- ✦ Implementation concurrent with EPA rule - 2006
 - No phase-in
 - No provisions for small refiners

Proposed Amendments for California Diesel Fuel (Continued)

- ✦ Update diesel certification fuel specifications

Future Diesel Fuel Activities

- ✦ Monthly workshops
- ✦ Proposed hearing date in July 2001?
- ✦ Diesel certification fuel update in November 2001

Diesel Fuel Lubricity

Lubricity Concerns with Low Sulfur/Aromatics Diesel

Sweden

- ✦ 1991 - Experienced diesel fuel lubricity problems with low sulfur fuel

California

- ✦ 1994 Governor's Diesel Fuel Task Force recommended a minimum lubricity level
- ✦ Refineries voluntarily maintained this level
- ✦ No lubricity related fuel pump damage was documented

Diesel Lubricity Tests

- ✦ Two existing ASTM test methods:
 - Scuffing Load Ball on Cylinder Lubricity Evaluator (SLBOCLE)
 - High Frequency Reciprocating Rig (HFRR)
- ✦ Neither test predicts the lubricity of all additive/fuel combinations
- ✦ Both tests under predict lubricity effect of additives resulting in over-additization
- ✦ Tests don't correlate well with each other

On-Going Efforts to Improve Lubricity Measurements

- ✦ ASTM Diesel Fuel Lubricity Task Force completing a major round robin program
- ✦ Objectives:
 - Acceptable precision
 - Responsive to all additive/fuel combinations
 - Correlation of measured lubricity levels to expected impacts on fuel injection equipment

ASTM Lubricity Guideline

- ✦ ASTM established a diesel fuel lubricity guideline as an appendix to their Diesel Fuel Oils Standard Specification (D 975-98a)
- ✦ Guideline defines levels which provide sufficient lubricity in all cases:
 - SLBOCLE values above 3,100 grams
 - HFRR method at 60°C value below 450 microns

No Official Standard for Diesel Fuel Lubricity Exists

- ✦ Equipment manufacturers believe lubricity standard necessary with 15 ppm diesel sulfur standard
- ✦ ASTM will consider a lubricity specification when test issues are resolved
- ✦ California Division of Measurement Standards (DMS) supports a diesel lubricity specification

ARB Efforts

- ✦ Beginning investigation
- ✦ Status report November 2001
- ✦ Propose regulation in November 2002?

Diesel Engine Lubrication Oils

Sulfur Levels in Lubrication Oils

- ✦ Sulfur content of diesel engine lubrication oils range from 2,500 to 8,000 ppm
- ✦ Diesel engines consume lubrication oils as part of their normal operation
- ✦ Consider impact of lube oil sulfur on control technology

Source of Sulfur in Lubricant Base Oil

- ✦ Petroleum origin
 - 100 ppm up to 4,000 ppm of sulfur
 - Sulfur can be removed by hydrotreating
- ✦ Synthetic origin
 - Sulfur free

Source of Sulfur in Lubricant Additives

- ✦ Includes sulfur compounds to improve performance characteristics of lubricants
- ✦ Can contribute about 3,000 ppm sulfur
- ✦ Availability of non-sulfur replacements?

Sulfur Contribution of Lubrication Oils from On-Road HDV Exhaust

(Worst Case Estimate)

- ✦ Assume:
 - Nominal oil usage of 1 quart every 2,000 miles
 - Heavy duty diesel engine fuel usage of 6 miles per gallon
 - Lubrication oil with 8,000 ppm of sulfur
- ✦ 7 ppm maximum equivalent fuel sulfur contribution

Ash Content in Lubrication Oils Can Impact Particulate Filter Regeneration

- ✦ Lubrication oil ash is inorganic and non-combustible
- ✦ Ash comes from the additives
- ✦ Lubrication oil ash content has been increasing from increased additive rates
- ✦ Impacts particulate filter regeneration due to non-combustible ash deposits

Lubricants Work Group

- ✦ Industry/government work group
 - Part of DOE's Advanced Petroleum-Based Fuels - Diesel Emissions Control (APBF-DEC) Program
 - Established Spring 2000
 - Charter : study effects of sulfur and other constituents in lubricants on emission control devices and engine-out emissions

Lubricants Workgroup Has Defined a Three Phase Plan

- ✦ Request for proposal (RFP) issued and proposals being evaluated for first phase
 - 12 month program
 - Testing to characterize:
 - Lubricant basestock effects on engine-out emissions
 - Lubricant additives effects on engine-out emissions
- ✦ Follow-up work:
 - Study how these engine-out emissions impact diesel emission control system performance

ARB Efforts

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Electronic Reporting Compliance Methods

CaRFG3 Issues

Gasoline Certification Fuel

- ✦ Plan regulatory update to the CaRFG2 certification fuel specifications
- ✦ Planning additional workshops in the near future
- ✦ Will work closely with auto, oil, and ethanol industries and the ARB Mobile Source Control Division
- ✦ Scheduled for consideration by the ARB Board in November 2001

Current Key CaRFG2 Certification Fuel Specifications

Property	Range
T50	200-210 °F
T90	290-300 °F
<u>Sulfur</u>	30-40 ppmw
RVP	6.7-7.0 psi
Olefins	4-6 vol % max
MTBE	10.8-11.2 vol%
<u>Ethanol</u>	N/A
Benzene	0.8-1.0 vol %

MTBE Deminimus Levels

- ✦ Review current CaRFG3 MTBE deminimus limits
- ✦ Deminimus levels may need to be established for other ethers/alcohols which can be present as contaminants

Ongoing Permeation Emission Evaluation

- ✦ Contract awarded to investigate potential permeation emissions losses
 - Performed literature search for permeation rates with ethanol and non-ethanol gasolines
 - Confirms ethanol increases permeation emission losses
 - Gathering data on permeable fuel system materials in vehicle fleet to estimate statewide permeation emissions
 - Will design test program to evaluate permeation rates to increase available data
- ✦ Draft report to be available this month

Ongoing Work on Commingling

- ✦ Board prohibited use of MTBE beginning December 31, 2002
- ✦ Federal oxygen requirement still in place
 - Ethanol only allowable oxygenate
 - 70% of California fuel
- ✦ Board directed the staff to evaluate real-world impacts of mixing ethanol and non-ethanol gasoline

Evaluation of Real-World Impacts

- ✦ ARB Commingling study
 - Establish ARB/Industry workgroup
 - Evaluate consumer refueling practices
 - In-use vehicle fuel sampling program
- ✦ Results to be presented to Board in November 2001

Future Activities